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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b).)

Attorney Docket No. IR25 US
First Inventor or Application Identifier KIA SILVERBROOK
Title A CAMERA EXCHANGE SYSTEM AND METHOD
Express Mail Label No. EK294884745US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ * Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 17]
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 9]
4. Oath or Declaration [Total Pages 3]
 - a. ☒ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
 - i. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

5. ☐ Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. ☐ Computer Readable Copy
 - b. ☐ Paper Copy (identical to computer copy)
 - c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. ☒ Assignment Papers (cover sheet & document(s))
8. ☐ 37 C.F.R. § 3.73(b) Statement of Attorney
(when there is an assignee)
9. ☐ English Translation Document (if applicable)
10. Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
11. Preliminary Amendment
12. Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. ☒ Small Entity Statement(s) ☐ Statement filed in prior application,
(PTO/SB/09-12) Status still proper and desired
14. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. Other:

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. _____

Prior application information: Examiner _____ Group / Art Unit _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

☒ Customer Number or Bar Code Label 24011 or ☐ Correspondence address below
(Insert Customer No. or Attach bar code label here)

| | | | |
|---------|------------------------------|-----------|---------------|
| Name | Kia Silverbrook | | |
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| City | Balmain | State | NSW |
| Country | AUSTRALIA | Telephone | 612-9818-6633 |
| | | Fax | 612-9818-6711 |

| | | | |
|-------------------|--------------------|-----------------------------------|----------------|
| Name (Print/Type) | Kia Silverbrook | Registration No. (Attorney/Agent) | |
| Signature | <i>[Signature]</i> | Date | Sept. 12, 2000 |

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Docket No.: IR25US

Certificate of Mailing under 37 CFR 1.8

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on September 15, 2000
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Submitted herewith Utility Patent Application Transmittal and enclosures for an invention entitled "A CAMERA EXCHANGE SYSTEM AND METHOD".

Express Mail Label:

EK294884745US

FEE TRANSMITTAL

for FY 2000

Patent fees are subject to annual revision.

Small entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/USB/09-12. See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$5) 385

Complete if Known

Application Number
 Filing Date
 First Named Inventor KIA SILVERBROOK
 Examiner Name
 Group / Art Unit
 Attorney Docket No. IR25US

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number
 Deposit Account Name
☐ Charge Any Additional Fee Required Under 37 CFR §§ 1.16 and 1.17

2. ☒ Payment Enclosed:
☒ Check ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

| Large Entity/Small Entity Code (\$) | Fee (\$) | Fee (\$) | Fee Description | Fee Paid |
|-------------------------------------|----------|----------|------------------------|----------|
| 101 690 203 345 | | | Utility filing fee | 345 |
| 106 310 206 155 | | | Design filing fee | |
| 107 480 207 240 | | | Plant filing fee | |
| 108 690 208 345 | | | Reissue filing fee | |
| 114 150 214 75 | | | Provisional filing fee | |

SUBTOTAL (1) (\$) 345

2. EXTRA CLAIM FEE

| Total Claims | Extra Claims | Fee from below | Fee Paid |
|--------------------|--------------|----------------|----------|
| 15 | -20** = 0 | x 9 | 0 |
| 2 | -3** = 0 | x 39 | 0 |
| Multiple Dependent | | | 0 |

**or number previously paid, if greater; For Reissues, see below

| Large Entity/Small Entity Code (\$) | Fee (\$) | Fee (\$) | Fee Description |
|-------------------------------------|----------|----------|--|
| 103 18 203 9 | | | Claims in excess of 20 |
| 102 78 202 39 | | | Independent claims in excess of 3 |
| 104 260 204 130 | | | Multiple dependent claim, if not paid |
| 109 78 209 39 | | | ** Reissue independent claims over original patent |
| 110 18 210 9 | | | ** Reissue claims in excess of 20 and over original patent |

SUBTOTAL (2) (\$) 0

3. ADDITIONAL FEES

| Large Entity/Small Entity Code (\$) | Fee (\$) | Fee (\$) | Fee Description | Fee Paid |
|-------------------------------------|----------|----------|--|----------|
| 105 130 205 65 | | | Surcharge - late filing fee or oath | |
| 127 50 227 25 | | | Surcharge - late provisional filing fee or cover sheet | |
| 139 130 139 130 | | | Non-English specification | |
| 147 2,520 147 2,520 | | | For filing a request for reexamination | |
| 112 920* 112 920* | | | Requesting publication of SIR prior to Examiner action | |
| 113 1,840* 113 1,840* | | | Requesting publication of SIR after Examiner action | |
| 115 110 215 55 | | | Extension for reply within first month | |
| 116 380 216 190 | | | Extension for reply within second month | |
| 117 870 217 435 | | | Extension for reply within third month | |
| 118 1,360 218 680 | | | Extension for reply within fourth month | |
| 128 1,850 228 925 | | | Extension for reply within fifth month | |
| 119 300 219 150 | | | Notice of Appeal | |
| 120 300 220 150 | | | Filing a brief in support of an appeal | |
| 121 290 221 130 | | | Request for oral hearing | |
| 138 1,510 138 1,510 | | | Petition to institute a public use proceeding | |
| 140 110 240 55 | | | Petition to revive - unavoidable | |
| 141 1,210 241 605 | | | Petition to revive - unintentional | |
| 142 1,210 242 605 | | | Utility issue fee (or reissue) | |
| 143 430 243 215 | | | Design issue fee | |
| 144 580 244 290 | | | Plant issue fee | |
| 122 130 122 130 | | | Petitions to the Commissioner | |
| 123 50 123 50 | | | Petitions related to provisional applications | |
| 126 240 126 240 | | | Submission of Information Disclosure Sheet | |
| 581 40 581 40 | | | Recording each patent assignment per property (times number of properties) | 40 |
| 146 690 246 345 | | | Filing a submission after final rejection (37 CFR § 1.129(a)) | |
| 149 690 249 345 | | | For each additional invention to be examined (37 CFR § 1.129(b)) | |

Other fee (specify) _____

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$) 40

SUBMITTED BY

| | | | | |
|-------------------|------------------------|-----------------------------------|----------------|--------------------------|
| Name (Print Type) | Kia Silverbrook | Registration No. (Attorney/Agent) | 24011 | Complete (if applicable) |
| Signature | <i>Kia Silverbrook</i> | Telephone | 61-2-9818-6633 | Date |
| | | | | September 12, 2000 |

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STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))—SMALL BUSINESS CONCERN

Docket Number (Optional)
 IR25US

Applicant, Patentee, or Identifier: Silverbrook Research Pty Ltd

Application or Patent No.: _____

Filed or issued: September 2000

Title: A CAMERA EXCHANGE SYSTEM AND METHOD

I hereby state that I am

- ☒ the owner of the small business concern identified below:
☐ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN Silverbrook Research Pty. Ltd.

ADDRESS OF SMALL BUSINESS CONCERN 393 Darling Street, Balmain, NSW 2041, Australia

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

- ☒ no such person, concern, or organization exists.
☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person/concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING Kia Silverbrook

TITLE OF PERSON IF OTHER THAN OWNER _____

ADDRESS OF PERSON SIGNING 393 Darling Street, Balmain, NSW 2041, Australia

SIGNATURE  DATE September 12, 2000

A CAMERA EXCHANGE SYSTEM AND METHOD

Field of the Invention

This invention relates to a recyclable, one-time use, print on demand, digital camera. More particularly, the invention relates to a camera exchange system and to a method of exchanging cameras of the type described.

Background to the Invention

One-time use cameras, making use of conventional photographic film, are becoming increasingly popular. A customer purchases the camera, exposes the film in the camera and returns the entire camera to a processing centre to have the exposed film processed. As far as the customer is concerned, the camera is, in that sense, a disposable camera. At the processing centre, the film is removed from the camera in darkroom conditions and is processed. The camera casing and remaining parts are, where possible, recycled.

We have also proposed the use of printing technology in a digital camera for more upmarket cameras and, in this regard, reference is made to our co-pending US application number 09/113,060 filed July 10, 1998 and entitled "Digital instant printing camera with image processing capability" (Docket Number ART01), the contents of which are specifically incorporated herein by reference.

The type of camera proposed in 09/113,060 is, as indicated, directed at the higher end of the market to compete with existing digital cameras.

We have also proposed, in our co-pending US application number 09/113,102 filed July 10, 1998 and entitled "A low cost disposable digital instant printing camera" (Docket Number IR01), the contents of which are also specifically incorporated herein by reference, a low cost, one-time use digital camera.

While it is believed that this low-cost camera, on its own, is of considerable commercial value, due to the high quality and instant printing of images which can be obtained, a camera exchange system and method are contemplated so that the camera of our co-pending application number 09/113,102 can compete in price with existing disposable, photographic film cameras.

Summary of the Invention

According to a first aspect of the invention, there is provided a camera exchange system which includes

a plurality of one-time use digital cameras, each camera including an authentication means; and

at least one refurbishing station for refurbishing used, returned cameras by replenishing consumables of each of said returned cameras, the authentication means of each camera authenticating whether or not said at least one refurbishing station is authorised to effect refurbishing of said camera.

Each camera may retail at a price of X currency units, each camera costing approximately Y currency units to manufacture where Y is less than 0.5X. In this specification the term "currency unit" is to be understood as US\$1, £1, AU\$1, Japanese Yen100, Italian Lire1000, or the like.

The system may include at least one collection depot where a user can return a used one of the cameras for a refund and a plurality of refurbishing stations operated by a manufacturer for receiving the used cameras from said at least one collection depot, each station being able to be authenticated by said used camera, to replenish the consumables of said used camera to enable a refurbished camera to be re-sold at X currency units, and the cost to said manufacture to refurbish the camera being Z currency units. The refund may be approximately 0.25X and Z may be approximately 0.03X.

The consumables which are replenished may include ink, a supply of paper and batteries of the power supply.

Also, at the time that the camera is refurbished, its outer casing may be removed and recycled. All the internal components of the camera are supported on a chassis which may be inserted into a new, recycled casing after replenishing of the consumables and resetting of a picture counter of the camera. A sleeve is placed about the re-cased camera.

A selling price of either one of a new and a refurbished camera by the manufacturer may be approximately 0.5X.

It is envisaged that, for a return for refund rate of approximately 90% of the cameras, a total gross margin as a percentage of sales exceeding 75% is achievable.

To ensure that the low cost cameras compete with disposable photographic film cameras, a cost to the user of each photo processed by the camera may be less than $0.05X$ if the user returns a used camera for refund.

According to a second aspect of the invention, there is provided a method of exchanging cameras which includes the steps of:

providing a plurality of one-time use digital cameras, each camera containing consumables which are consumed by use of the camera;

receiving returned, used cameras to be refurbished by replenishment of the consumables to provide refurbished cameras; and

authenticating, via each of said returned cameras, that a refurbishing station at which said camera is refurbished is authorised to effect refurbishing of said camera.

The method may include rendering a camera refurbished by an unauthorised refurbishing station inoperative. Further, the method may include carrying out a test routine after refurbishing to determine if the refurbished camera is operative. The test routine for testing a refurbished camera may automatically test that the camera is operative.

The method may include

selling each camera at a retail price of approximately X currency units, each camera costing approximately Y currency units to manufacture where Y is less than $0.5X$;

refunding an amount for the return of a used camera; and

refurbishing each returned, used camera at a cost to a refurbisher of Z currency units.

The method may include refunding an amount of approximately $0.25X$ for the return of a used camera and Z may be approximately $0.03X$.

The method may then include supplying refurbished cameras to a retailer at a cost of approximately $0.5X$ currency units.

Brief Description of the Drawings

The invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a flow chart of a camera exchange system, and method of exchanging cameras, in accordance with the invention;

Figure 2 shows a three dimensional view of the type of camera to be exchanged;

Figure 3 shows a three dimensional, exploded view of an ink cartridge assembly of the camera of Figure 2;

Figure 4 shows a three dimensional, exploded view of the insertion of a supply of print media and a power supply in the camera during refurbishing thereof;

Figure 5 shows the re-assembly of a chassis of the camera after installation of the supply of print media and power supply;

Figure 6 shows a three dimensional view of the insertion of a platen forming part of the camera;

Figure 7 shows the installation of the re-assembled chassis in a front shell of a casing of the camera;

Figure 8 shows the mounting of a rear shell of the casing on to the front shell;

Figure 9 illustrates a single authentication chip data protocol; and

Figure 10 illustrates a dual authentication chip data protocol.

Detailed Description of the Drawings

Referring initially to Figure 1 of the drawings, a flow chart of a camera exchange system or a method of exchanging cameras is illustrated and is designated generally by the reference numeral 10. The camera in question is a low cost, recyclable, one-time use, print on demand, digital camera 12 (Figure 2) and will be described in greater detail below.

In the exchange system, old cameras are collected, as shown at step 14 at collection depots.

By "old cameras" is meant a camera which has been used by a user to take a predetermined number of pictures. As indicated, the camera 12 is a digital, instant printing camera. Typically, the camera 12 has a supply of print media 16 (Figure 4) for enabling

twenty-five pictures to be printed. For ease of reference, and in accordance with conventional camera technology, these pictures will be referred to as exposures.

In accordance with the camera exchange system of the invention, a camera 12, when new has a manufacturing cost of Y currency units. For ease of explanation, the currency unit used in this description will be the US dollar. At present rates, the manufacturing cost of the camera is estimated to be slightly less than \$10.00 and, more particularly, in the region of about \$9.50. Specifically, a costing analysis reveals that the manufacturing cost of such a camera is in the region of \$9.48.

New cameras are supplied to retailers by the manufacturer at a cost of approximately \$10.00 so that the return to the manufacturer, in respect of new cameras, will be of the order of about 0.5%.

Also, the camera is retailed by the retailer at a cost of \$20.00. When the camera 12 has been used, the old or used camera 12 is returned to the collection depot where a refund of \$5.00 is made to the person returning the camera. As a result, the net price to the consumer is \$15.00. For a twenty five exposure camera 12, the cost to the consumer for each photo is of the order of \$0.60. This equates almost exactly to the present cost of a developed, printed photo taken using a conventional film camera.

Due to the cost of the camera to the consumer, factoring in the refund, and the cost per photo, the consumer, effectively, obtains a digital, instant printing camera at a price similar to that of a disposable, one-time use conventional film camera and the cost of each image or exposure of the digital camera 12 is of the same order as that of the conventional camera.

It will, of course, be appreciated that due to the fact that the camera 12 is a digital camera, it is not necessary for the camera 12 to be returned for processing. Accordingly, an incentive needs to be given for the used cameras 12 to be returned; hence the refund. It is felt that, should adult consumers not bother to return the cameras, it is still likely that children or low income members of the community would return the cameras to obtain the refund.

When the used camera 12 is returned, the camera 12 is refurbished and replenished. The refurbished camera is re-packaged and returned to the retailer.

The approximate cost to the manufacturer of refurbishing a camera 12 is as follows:-

| Refill Part or Process | Cost |
|-----------------------------------|----------------|
| 3.75 meters x 100mm coated paper | \$0.20 |
| Ink (8ml each CMY) | \$0.06 |
| 2 x 1.5V AA cells | \$0.20 |
| Recycled molded outer front shell | \$0.02 |
| Recycled molded outer back shell | \$0.02 |
| Paper camera label | \$0.005 |
| Automated retesting | \$0.05 |
| Sealed plastic bag | \$0.005 |
| Cardboard box | \$0.005 |
| Automated packing | \$0.005 |
| Manual sorting and handling | \$0.05 |
| Transport | \$0.05 |
| Total | \$0.670 |

The manufacturer supplies such a refurbished camera to the retailer at a similar wholesale cost to a new camera, i.e. US\$10.00 so that the gross margin to the manufacturer on refill is of the order of US\$9.33.

Further, it is envisaged that, in due course, the ratio of used cameras which are recycled and returned into the market to new cameras will be of the order of 9:1 assuming an estimated camera return-for-refund rate of 90%. Should this figure be obtained, it is estimated that the total gross margin as a percentage of sales which the manufacturer will achieve will be in the order of 77%.

Due to this rate of return, the business model can weather significant retail price pressure and maintain profitability.

An interesting conclusion is that digital printing cameras can be provided having a lower retail price than non-printing digital cameras.

With reference to Figures 2 to 8 of the drawings, a brief description of the refurbishing of the camera will be described following the steps of Figure 1.

The camera 12 has a casing 18 made up of a front shell 20 and a rear shell or lid 22. The casing 18 has a coated paper sleeve 24 covering a major part thereof. Further, in a

conventional fashion, the camera 12 has a viewfinder 26, an imaging lens 28 and an "exposure" taking button 30.

In the recycling of the camera 12, the casing 18 is removed (step 32 in Figure 1). As illustrated at 34 in Figure 1, the shells 20 and 22 of the casing 18 are sent for recycling and are remolded, as illustrated at 36 to form new shells 20 and 22 of the casing 18 for another camera.

Once the casing 18 has been removed, a chassis 38 of the camera is exposed. The chassis 38 carries all internal components of the camera. For a more detailed description of these components, reference is made to our co-pending US application number 09/113,102 referred to above.

The supply of print media 16 is in the form of a roll of coated paper carried on a former 40. It will be appreciated that, once the twenty-five exposures have been made, all that will remain in the used camera 12 is the former 40. An end member 42 of the chassis is removed to enable the former 40 to be removed. The former 40 houses batteries 44 for the camera 12 therein to render the camera 12 compact. Accordingly, when the end member 42 of the chassis 38 has been removed, access can be gained to the used batteries 44 which are replaced by fresh batteries.

Hence, once the end member 42 has been removed and the former 40 and batteries 44 of the old camera 12 have been removed, a new print media supply 16 and batteries 44 are loaded on to the chassis 38 and are retained in position by the end member 42. This is shown at step 46 in Figure 1.

The chassis 38 supports an ink cartridge 48 thereon. An exploded view of the ink cartridge 48 is shown in greater detail in Figure 3 of the drawings. The ink cartridge has a lower carrier 50 which carries the print head chip 52. The print head chip 52 is a Memjet (Memjet is a trade mark of Silverbrook Research Pty Limited). The print head chip 52 is a photowidth or pagewidth print head and prints one line at a time on print media passing beneath the print head chip 52, in use.

The cartridge 48 further includes a cover member 54 which mates with the carrier 50 to define three chambers 56, 58 and 60. Each chamber 56, 58 and 60 carries a different color ink therein so that full color printing can be achieved by the print head chip 52. Each

chamber 56, 58 and 60 houses a damping means in the form of a sponge 62, 64 and 66, respectively, therein for damping movement of ink within the chambers 56, 58 and 60.

An end wall 68 of the carrier 50 has labyrinthine openings 70 defined therein. These openings 70 are exposed by removal of a seal 72 when it is desired to refill the chambers 56, 58 and 60. Accordingly, to refill the chambers 56, 58 and 60, a plug 74 is removed. The plug 74 has three prongs 76. Each prong 76 closes off an inlet port to one of the chambers 56, 58 and 60. Accordingly, ink is charged into each of the chambers. For example, cyan ink may be received in the chamber 56, magenta ink may be received in the chamber 58 and yellow ink may be received in the chamber 60. Once the chambers 56, 58 and 60 have been charged with new ink, the plug 74 is replaced and a new seal 72 is applied to cover the openings 70.

The refilling of the ink cartridge is shown at step 78 in Figure 1 of the drawings. The replenished camera, without the case, is then ready for testing (step 80 in Figure 1).

The caseless camera, as shown in Figure 5 of the drawings, is then tested by the automatic test routine. In particular, the camera is tested to ensure paper feed and ink flow. Most importantly, the camera is tested to ensure that it has been replenished by an authorised refilling station to ensure that a camera of the required quality is put on to the market. The camera includes an image processing chip 82. Part of the image processing chip 82 has the authentication program contained therein which authenticates that the refurbishing station is authorised (step 84 in Figure 1). Should the chip 82 determine that the refurbishing station is unauthorised, the chip 82 renders the refurbished camera inoperative.

The part of the image processing chip 82 which includes the authentication program is a flash memory. The flash memory is used to store a 128 bit authentication code. This provides higher security than storage of the authentication code in ROM as reverse engineering can be made essentially impossible. The flash memory is completely covered by third level metal, making the data almost impossible to extract using scanning probe microscopes or electron beams. The authentication code is stored in the chip when manufactured. At least two other flash bits are required for the authentication process: a bit which locks out re-programming of the authentication code and a bit which indicates that the camera has been refilled by an authenticated refill station.

This data are used by a central processing unit of the chip 82 to effect encrypted authentication of the refill station.

The authentication station communicates with the chip 82 via a standard joint test action group (JTAG) interface. This interface also is provided for the testing routine.

To ensure that the cameras are only refilled with quality print media and ink at a properly authorised refill station, the camera 12 authenticates the refill station rather than vice versa. The secure protocol is communicated to the refill station during the automated test procedure via the interface when the new ink is inserted into the cartridge 48.

Authentication

Existing solutions to the problem of authenticating consumables have typically relied on physical patents on packaging. However this does not stop home refill operations or clone manufacture in countries with weak industrial property protection. Consequently a much higher level of protection is required. It is not enough to provide an authentication method that is secret, relying on a home-brew security method that has not been scrutinized by security experts. Security systems such as Netscape's original proprietary system and the GSM Fraud Prevention Network used by cellular phones are examples where design secrecy caused the vulnerability of the security. Both security systems were broken by conventional means that would have been detected if the companies had followed an open design process. The solution is to provide authentication by means that have withstood the scrutiny of experts. A number of protocols that can be used for consumables authentication. We only use security methods that are publicly described, using known behaviors in this new way. For all protocols, the security of the scheme relies on a secret key, not a secret algorithm. All the protocols rely on a time-variant challenge (i.e. the challenge is different each time), where the response depends on the challenge and the secret. The challenge involves a random number so that any observer will not be able to gather useful information about a subsequent identification. Two protocols are presented for each of Presence Only Authentication and Consumable Lifetime Authentication. Although the protocols differ in the number of Authentication Chips required for the authentication process, in all cases the System authenticates the consumable. Certain protocols will work with either one or two chips, while other protocols only work with two chips. Whether one chip or two

Authentication Chips are used the System is still responsible for making the authentication decision.

Single Chip Authentication

When only one Authentication chip 53 is used for the authentication protocol, a single chip (referred to as **ChipA**) is responsible for proving to a system (referred to as **System**) that it is authentic. At the start of the protocol, System is unsure of ChipA's authenticity. System undertakes a challenge-response protocol with ChipA, and thus determines ChipA's authenticity. In all protocols the authenticity of the consumable is directly based on the authenticity of the chip, i.e. if ChipA is considered authentic, then the consumable is considered authentic. The data flow can be seen in Fig. 9. In single chip authentication protocols, System can be software, hardware or a combination of both. It is important to note that System is considered insecure – it can be easily reverse engineered by an attacker, either by examining the ROM or by examining circuitry. System is not specially engineered to be secure in itself.

Double Chip Authentication

In other protocols, two Authentication Chips are required as shown in Fig. 10. A single chip (referred to as **ChipA**) is responsible for proving to a system (referred to as **System**) that it is authentic. As part of the authentication process, System makes use of a trusted Authentication Chip (referred to as **ChipT**). In double chip authentication protocols, System can be software, hardware or a combination of both. However ChipT must be a physical Authentication Chip. In some protocols ChipT and ChipA have the same internal structure, while in others ChipT and ChipA have different internal structures.

Presence Only Authentication (Insecure State Data)

For this level of consumable authentication we are only concerned about validating the presence of the Authentication chip 53. Although the Authentication Chip can contain state information, the transmission of that state information would not be considered secure. Two protocols are presented. Protocol 1 requires 2 Authentication Chips, while Protocol 2 can be implemented using either 1 or 2 Authentication Chips.

Protocol 1

Protocol 1 is a double chip protocol (two Authentication Chips are required). Each Authentication Chip contains the following values:

- K** Key for $F_K[X]$. Must be secret.
- R** Current random number. Does not have to be secret, but must be seeded with a different initial value for each chip instance. Changes with each invocation of the Random function.

Each Authentication Chip contains the following logical functions:

Random[] Returns R, and advances R to next in sequence.

F[X] Returns $F_K[X]$, the result of applying a one-way function F to X based upon the secret key K.

The protocol is as follows:

System requests Random[] from ChipT;

ChipT returns R to System;

System requests F[R] from both ChipT and ChipA;

ChipT returns $F_{KT}[R]$ to System;

ChipA returns $F_{KA}[R]$ to System;

System compares $F_{KT}[R]$ with $F_{KA}[R]$. If they are equal, then ChipA is considered valid. If not, then ChipA is considered invalid.

The data flow can be seen in Fig. 169. The System does not have to comprehend $F_K[R]$ messages. It must merely check that the responses from ChipA and ChipT are the same. The System therefore does not require the key. The security of Protocol 1 lies in two places:

The security of $F[X]$. Only Authentication chips contain the secret key, so anything that can produce an $F[X]$ from an X that matches the $F[X]$ generated by a trusted Authentication chip 53 (ChipT) must be authentic.

The domain of R generated by all Authentication chips must be large and non-deterministic. If the domain of R generated by all Authentication chips is small, then there is no need for a clone manufacturer to crack the key. Instead, the clone manufacturer could incorporate a ROM in their chip that had a record of all of the responses from a genuine chip to the codes sent by the system. The Random function does not strictly have to be in the Authentication Chip, since System can potentially generate the same random number sequence. However it simplifies the design of System and ensures the security of the random number generator will be the same for all implementations that use the Authentication Chip, reducing possible error in

system implementation.

Protocol 1 has several advantages:

K is not revealed during the authentication process

Given X , a clone chip cannot generate $F_K[X]$ without K or access to a real Authentication Chip.

System is easy to design, especially in low cost systems such as ink-jet printers, as no encryption or decryption is required by System itself.

A wide range of keyed one-way functions exists, including symmetric cryptography, random number sequences, and message authentication codes.

One-way functions require fewer gates and are easier to verify than asymmetric algorithms).

Secure key size for a keyed one-way function does not have to be as large as for an asymmetric (public key) algorithm. A minimum of 128 bits can provide appropriate security if $F[X]$ is a symmetric cryptographic function.

However there are problems with this protocol:

It is susceptible to chosen text attack. An attacker can plug the chip into their own system, generate chosen R s, and observe the output. In order to find the key, an attacker can also search for an R that will generate a specific $F[M]$ since multiple Authentication chips can be tested in parallel.

Depending on the one-way function chosen, key generation can be complicated. The method of selecting a good key depends on the algorithm being used. Certain keys are weak for a given algorithm.

The choice of the keyed one-way functions itself is non-trivial. Some require licensing due to patent protection.

A man-in-the middle could take action on a plaintext message M before passing it on to ChipA – it would be preferable if the man-in-the-middle did not see M until after ChipA had seen it. It would be even more preferable if a man-in-the-middle didn't see M at all. If F is symmetric encryption, because of the key size needed for adequate security, the chips could not be exported from the USA since they could be used as strong encryption devices. If Protocol 1 is implemented with F as an asymmetric encryption algorithm, there is no advantage over the symmetric case – the keys need to be longer and the encryption

algorithm is more expensive in silicon. Protocol 1 must be implemented with 2 Authentication Chips in order to keep the key secure. This means that each System requires an Authentication Chip and each consumable requires an Authentication Chip.

Paper, from the supply 16, is wound about a platten 86 (Figure 6). In normal use, the platten 86 has a paper cutting mechanism 88 thereon which, once an image has been printed on the paper and the paper has been fed out of an ejection slot 90 (Figure 8) of the rear cover or shell 22 of the casing 18, cuts that piece from the remainder of the supply 16. The cutting mechanism 18 includes a pawl 92 which engages ratchet-like teeth 94 of an exposure counter 96 during the cutting operation to advance the counter by one.

Should the chip 82 determine that the refurbishing station is an authorised station, the counter 96 is reset as shown at step 98 in Figure 1 of the drawings.

Due to the digital processing of images sensed by the image sensor 28 of the camera 12, it is possible for special effects to be imparted to those images. Accordingly, special types of cameras may be made available, such as for the production of sepia colored photographs, multiple passport type photographs, photographs relating to special events such as weddings, special sporting events, or the like. This modification of the standard image is effected by the image processing chip 82. Such special types of cameras are identifiable as such by means of an appropriately marked sleeve 24. When, however, the cameras are refurbished, the image processing chip 82 is reset to a standard type as shown at step 100 by the refurbishing station.

The refurbishing and replenishing of the camera is then completed and the final step involves the insertion of the new chassis 38, with its components, into a new front cover 20 of the casing 12 and the attachment of a rear cover or lid 22. The lid 22 clips to the front cover 20 and is also bonded thereto so that should an attempt be made to open the casing 18, this will result in the destruction of the casing 18.

A new sleeve 24 is applied to the casing 18. The sleeve 24 is held in position by a slot surround 102.

The steps of attaching a new case 18 and applying the label or sleeve 24 are shown at 104 and 106, respectively, in Figure 1 of the drawings.

The refurbished camera 12 is packed (step 108 in Figure 1) and shipped (step 110 in Figure 1) to retailers.

Accordingly, a camera exchange system and method of exchanging cameras are provided which enables instant printing, digital cameras to compete with conventional film, one-time use cameras both in so far as costs of the cameras and costs of each exposure are concerned. Further, by authenticating the refilling station, quality control can be maintained to ensure that the quality of exposures obtained by consumers is of a satisfactory quality.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

WE CLAIM:

1. A camera exchange system which includes
a plurality of one-time use, digital cameras, each camera including an authentication means; and
at least one refurbishing station for refurbishing used, returned cameras by replenishing consumables of each of said returned cameras, the authentication means of each camera authenticating whether or not said at least one refurbishing station is authorised to effect refurbishing of said camera.
2. The system of claim 1 in which each camera retails at a price of X currency, each camera costing approximately Y currency units to manufacture, where Y is less than 0.5X.
3. The system of claim 2 which includes
at least one collection depot where a user can return a used one of the cameras for a refund; and
a plurality of refurbishing stations operated by a manufacturer for receiving the used cameras from said at least one collection depot, each station being able to be authenticated by said used camera, to replenish the consumables of said used camera to enable a refurbished camera to be re-sold at X currency units, and the cost to said manufacturer to refurbish the camera being Z currency units.
4. The system of claim 3 in which the refund is approximately 0.25X.
5. The system of claim 3 in which Z is approximately 0.03X.
6. The system of claim 1 in which a selling price of either one of a new and a refurbished camera by the manufacturer is approximately 0.5X.
7. The system of claim 1 in which, for a return for refund rate of approximately 90% of the cameras, a total gross margin as a percentage of sales exceeding 75% is achieved.

8. The system of claim 1 in which a cost to the user of each photo processed by the camera is less than $0.05X$ if the user returns a used camera for refund.
9. A method of exchanging cameras which includes the steps of:
 - providing a plurality of one-time, use digital cameras, each camera containing consumables which are consumed by use of the camera;
 - receiving returned, used cameras to be refurbished by replenishment of the consumables to provide refurbished cameras; and
 - authenticating, via each of said returned cameras, that a refurbishing station at which said camera is refurbished is authorised to effect refurbishing of said camera.
10. The method of claim 9 which includes rendering a camera refurbished by an unauthorised refurbishing station inoperative.
11. The method of claim 10 which includes carrying out a test routine after refurbishing to determine if the refurbished camera is operative.
12. The method of claim 9 which includes
 - selling each camera at a retail price of approximately X currency units, each camera costing approximately Y currency units to manufacture where Y is less than $0.5X$;
 - refunding an amount for the return of a used camera; and
 - refurbishing each returned, used camera at a cost to a refurbisher of Z currency units.
13. The method of claim 12 which includes refunding an amount of approximately $0.25X$ for the return of a used camera.
14. The method of claim 12 in which Z is approximately $0.03X$.
15. The method of claim 12 which includes supplying refurbished cameras to a retailer at a cost of approximately $0.5X$ currency units.

ABSTRACT

A camera exchange system includes a plurality of one-time use, digital cameras. Each camera includes an authentication device. The system includes at least one refurbishing station for refurbishing used, returned cameras by replenishing consumables of each of said returned cameras. The authentication device of each camera authenticates whether or not the refurbishing station is authorised to effect refurbishing of the camera.

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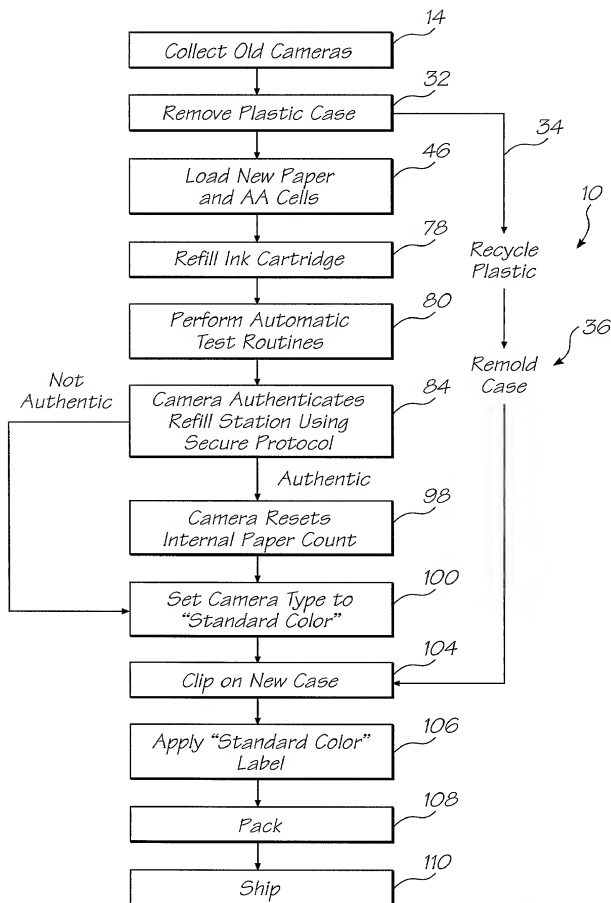


FIG. 1

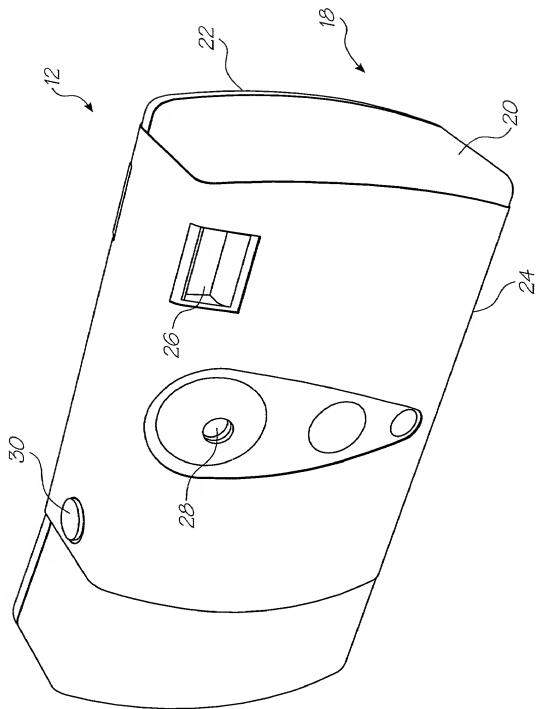
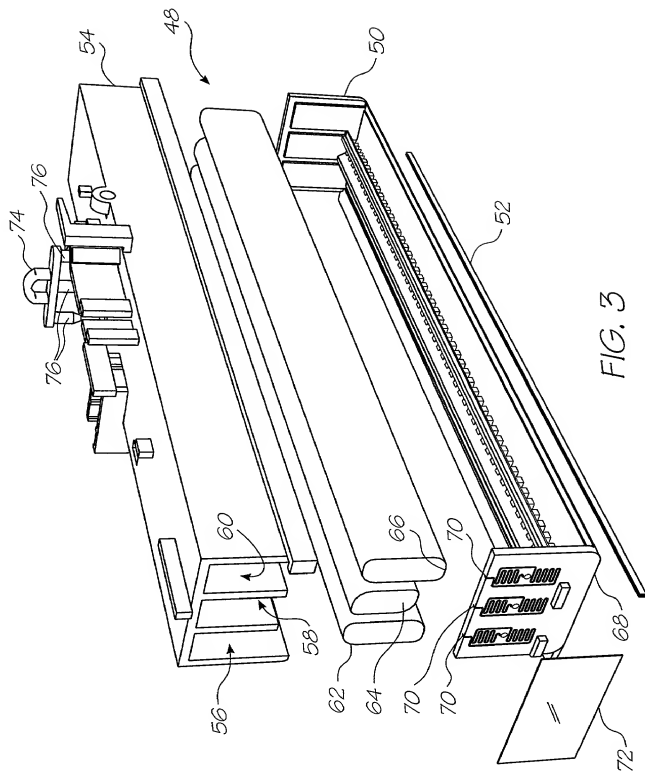


FIG. 2



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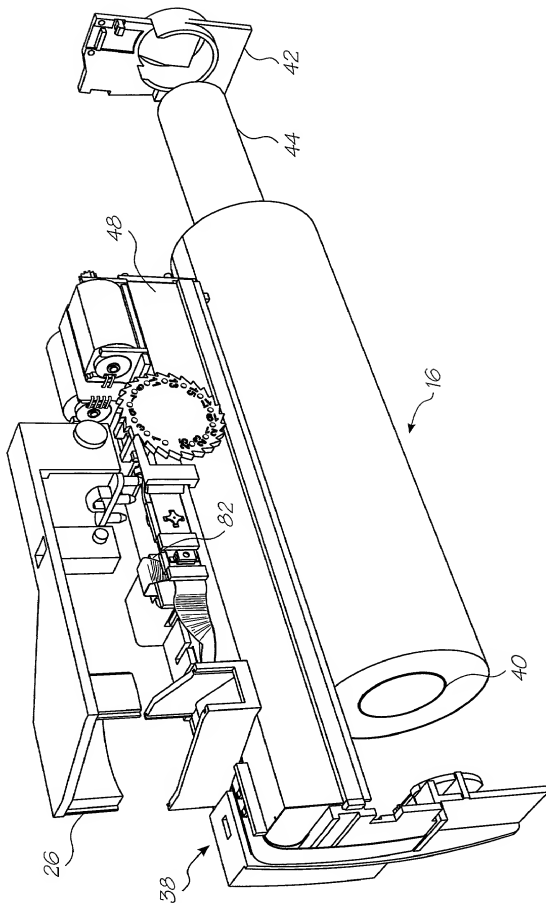


FIG. 4

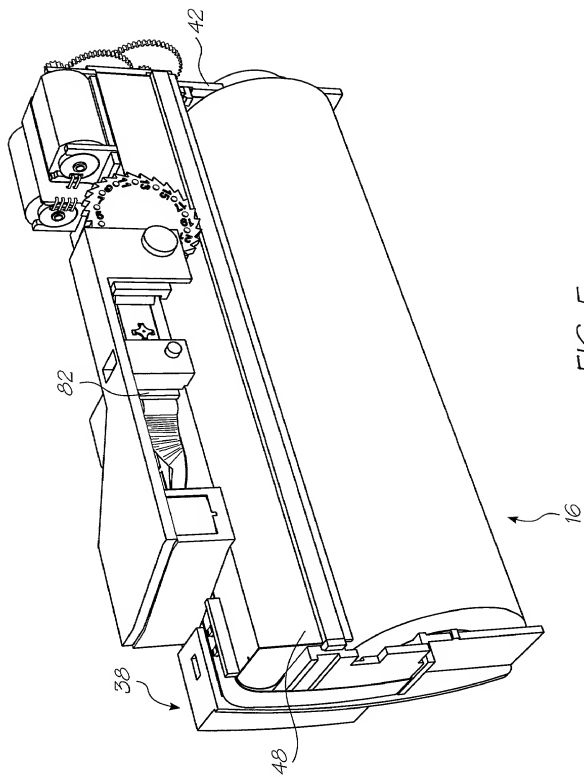


FIG. 5

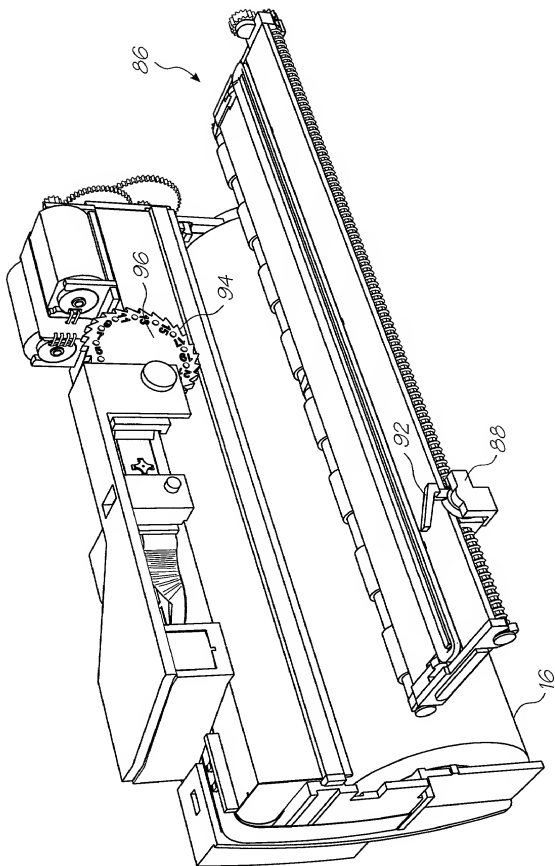


FIG. 6

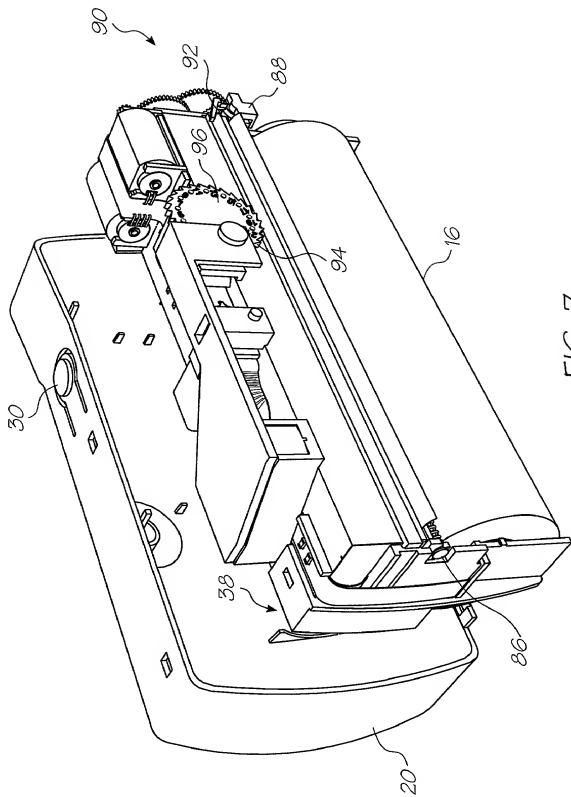


FIG. 7

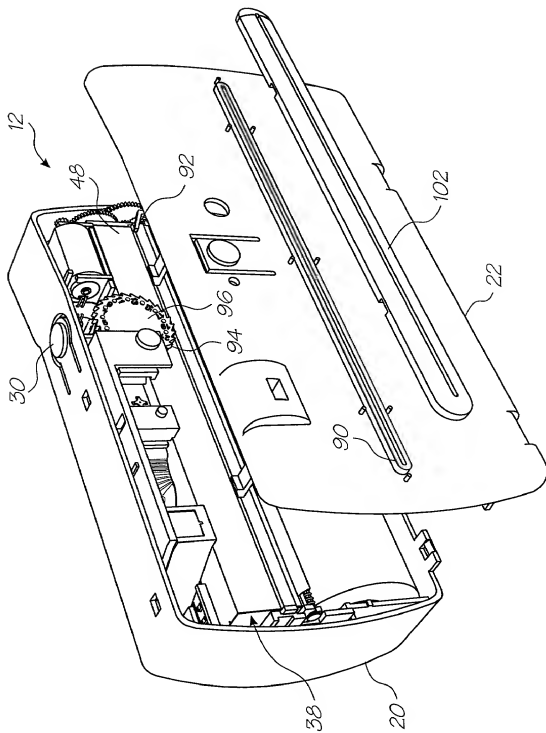


FIG. 8

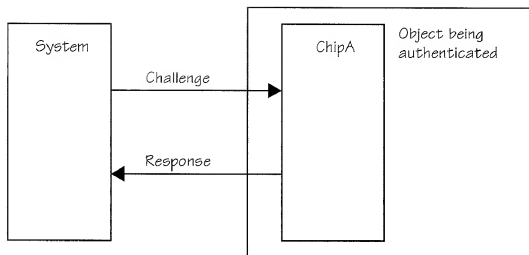


FIG. 9

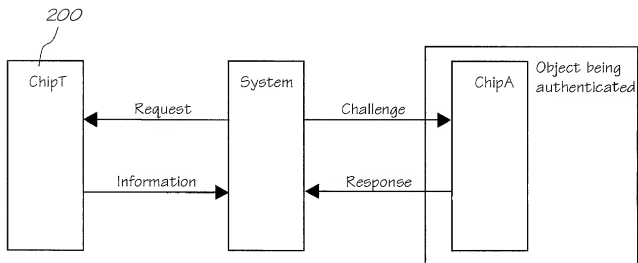


FIG. 10

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| | First Named Inventor | KIA SILVERBROOK |
| | COMPLETE IF KNOWN | |
| | Application Number | / |
| | Filing Date | |
| | Group Art Unit | |
| | Examiner Name | |

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A CAMERA EXCHANGE SYSTEM AND METHOD

the specification of which (Title of the Invention)

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International

Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(e) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

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[Page 1 of 2]

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U.S. Parent Application or PCT Parent Number

Parent Filing Date (MM/DD/YYYY)

Parent Patent Number (if applicable)

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
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:

☐ A petition has been filed for this unsigned inventor

| | | | | | |
|--|---|------------------------|-----|-------------|----------------|
| Given Name (first and middle (if any)) | | Family Name or Surname | | | |
| KIA | | SILVERBROOK | | | |
| Inventor's Signature |  | | | Date | Sept. 12, 2000 |
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| Post Office Address | | | | | |
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